

P1.33 EXTENDING THE PRECIPITATION MAP OFFSHORE USING DAILY AND 3-HOURLY COMBINED PRECIPITATION ESTIMATES

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1. INTRODUCTION

One of the difficulties in studying landfalling extratropical cyclones along the Pacific Coast is the lack of antecedent data over the ocean, including precipitation. Recent research on combining various satellite-based precipitation estimates opens the possibility of realistic precipitation estimates on a global $1^\circ \times 1^\circ$ latitude-longitude grid at the daily or even 3-hourly interval. The goal in this work is to provide quantitative precipitation estimates that correctly represent the precipitation-related variables in the hydrological cycle: surface accumulations (fresh-water flux into oceans), frequency and duration statistics, net latent heating, etc.

2. DAILY ESTIMATES

The Global Precipitation Climatology Project (GPCP) began collecting a 3-hourly $1^\circ \times 1^\circ$ global geo-IR dataset of brightness temperature (T_b) histograms in late 1996, enabling development of a correspondingly fine scale set of precipitation estimates. The GPCP One-Degree Daily (1DD) dataset is the authors' first technique for estimating global daily precipitation at the $1^\circ \times 1^\circ$ scale from observationally-based data (Huffman et al. 2001). It is currently available for 1997 – (delayed) present.

Where possible, (40°N-S) the Threshold-Matched Precipitation Index (TMPI) provides precipitation estimates similar to the Geosynchronous Operational Environmental Satellite (GOES) Precipitation Index (GPI) in which:

- the geo-IR T_b threshold (T_{b0}) is set locally from month-long accumulations of time/space coincident geo-IR T_b and precipitation frequency based on Special Sensor Microwave/Imager (SSM/I) data; and
- the conditional rain rate is set locally from the resulting frequency of $T_b < T_{b0}$ for the entire

month and the GPCP Version 2 Satellite-Gauge combined precipitation product (SG).

Scaled low-orbit IR GPI is used to fill holes in individual 3-hrly geo-IR images.

Outside 40°N-S the 1DD is based on Television Infrared-Visible Operational Sensor (TIROS) Operational Vertical Sounder (TOVS):

- the number of TOVS rain days are reduced to match TMPI rain days;
- TOVS precipitation by zeroing the (1-ratio) smallest daily TOVS rain accumulations; and
- the remaining (non-zero) TOVS rain days are rescaled to sum to the monthly SG.

The time series of the global images shows good continuity in time and space across the data boundaries. The latter presumably arises because both the TMPI and rescaled TOVS are responding to cloud information. Qualitatively, the time series of data images gives impressive views of the storms and fronts propagating across North Pacific prior to landfall on the West Coast of the U.S.

Validation against the dense Oklahoma Mesonet rain gauge network for individual grid box values shows a very high RMS error, as expected, but statistics improve when time/space averaging is performed. Preliminary validation against dense rain gauge networks in Australia appears to show poorer performance in mid-latitude wintertime situations where non-precipitating cirrus is prevalent.

3. THREE-HOURLY ESTIMATES

Currently we are working towards global 3-hourly precipitation fields. At present we are experimenting with the geo-IR zone (40°N-S). Similar to the 1DD, we are

- scale SSM/I estimates to TRMM TMI estimates;
- combine the TMI and scaled SSM/I to create a high-quality (HQ) estimate;
- make geo-IR pixel rainrates a function of the depression of the T_b below the HQ-based T_{b0} threshold; and
- replace geo-IR estimates with the HQ estimates, where available.

There are substantial questions about how to perform the combination, but working at the instantaneous level avoids the diurnal sampling bias

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issue. The immediate advantage of the combination is that it provides the "best" instantaneous estimate, when available, and a reasonable estimate at other times. In the future we plan to employ a more-sophisticated approach to combining the HQ with the geo-IR estimate for individual 3-hourly fields.

Outside the zone 40°N-S we are compositing the orbit-level rescaled TOVS in 3-hourly segments, centered on the time of interest, and combining them with similarly-prepared HQ (SSM/I-only) data. These composites do contain gaps.

The 3-hourly estimates show large RMS differences from observed rainrates, but they do a reasonable good job at reproducing the histograms of rainrates observed for the month. Thus, at least in a probabilistic sense the time series of precipitation is representative. The advantage of the 3-hourly over the daily is that users are free to tailor averages or composites of the data to their own needs.

4. FUTURE PROSPECTS

The whole topic of multi-platform, multi-sensor combined precipitation estimates is still quite new at synoptically-useful scales. It is difficult to make estimates with reasonable error statistics at the scales required to study synoptic systems before 1997 due to limited input data. However, the continued development of computing power and new satellites is enabling

some exciting new input datasets. Specifically, nearly full resolution, half-hourly (when available) global geo-IR datasets are now being produced. At the same time, the National Aeronautics and Space Administration has proposed development of the Global Precipitation Mission (GPM). Starting in 2007, GPM is planned to provide global 3-hourly passive microwave data by adding new, low-cost satellites to fill the gaps in current and planned passive microwave satellites, and to provide a TRMM-like satellite to calibrate all the passive microwave estimates on an on-going basis. We expect a permanent role for the geo-IR in filling the inevitable gaps in microwave coverage, as well as enabling sub-3-hourly precipitation estimates at fine spatial scales. The finer time/space resolution in the geo-IR data will facilitate implementation of more-sophisticated algorithms. Such an improvement is important to control the non-raining cirrus problem typical of simple IR algorithms at mid-latitudes. As well, we expect a great deal of development of theory and application for estimating errors in the various estimates. This error information is crucial for initializing models.

5. REFERENCES

- Huffman, G.J., R.F. Adler, S. Curtis, M. Morrissey, J.E. Janowiak, B McGavock, J. Susskind, 2001: Global Precipitation at One-Degree Daily Resolution from Multi-Satellite Observations. *J. Hydrometeor.*, in revision.